

What is claimed is:

1. A magnet structure, comprising:

a frame supporting first and second opposing permanent magnet assemblies;

5 wherein the frame includes

a base,

first and second extensions connected to the base and to the respective first and second opposing permanent magnet assemblies, and

10 first and second support structures supporting the respective first and second opposing permanent magnet assemblies with respect to the base; and

wherein the first and second opposing permanent magnet assemblies each include

an enclosure having an open end,

15 a pole face disposed on the enclosure and arranged such that it faces the pole face of the other permanent magnet assembly,

a magnetic mass disposed within the enclosure, and

a cover over the open end of the enclosure.

20 2. The magnet structure of claim 1, wherein the magnetic mass is a plurality of bricks made from a first magnetic material.

3. The magnet structure of claim 1, wherein the enclosure is box-shaped.

4. The magnet structure of claim 3, wherein the magnetic mass is a plurality of bricks made from a first magnetic material.

5 5. The magnet structure of claim 4, wherein the bricks are stacked so as to substantially conform to the shape of the enclosure and filling the enclosure.

6. The magnet structure of claim 5, further comprising a brace connected between the cover and a first side of the enclosure on which the pole face is disposed.

7. The magnet structure of claim 5, further comprising a brace connected between a first side of the enclosure, and a second side of the enclosure on which the pole face is disposed.

8. The magnet structure of claim 4, wherein the bricks include main bricks oriented so as to direct a main magnetic field in a first direction, and bucking bricks oriented to direct a blocking magnetic field in a second direction.

9. The magnet structure of claim 8, wherein the main bricks are disposed behind the respective pole face and direct the main magnetic field generally toward the respective pole face, and the bucking bricks are disposed to one side

of an outside periphery of the respective pole face and direct the blocking magnetic field toward a center line of the respective pole face.

10. The magnet structure of claim 8, wherein the main bricks are
5 disposed behind the respective pole face and direct the main magnetic field generally toward the respective pole face, and the bucking bricks are disposed on two opposite sides of an outside periphery of the respective pole face and direct the blocking magnetic field toward a center line of the respective pole face.

10 11. The magnet structure of claim 8, wherein
the main bricks are disposed behind the respective pole face and direct the main magnetic field generally toward the respective pole face, and
the bucking bricks include first bucking bricks and second bucking bricks,
wherein

15 the first bucking bricks are disposed at a first side of an outside periphery of the respective pole face and direct the blocking magnetic field toward a first center line of the respective pole face, and

the second bucking bricks are disposed at a second side of the outside periphery of the respective pole face, adjacent the first side of the outside
20 periphery of the respective pole face, and direct the blocking magnetic field toward a second center line of the respective pole face.

12. The magnet structure of claim 8, wherein

the main bricks are disposed behind the respective pole face and direct the main magnetic field generally toward the respective pole face, and

the bucking bricks include first bucking bricks and second bucking bricks, wherein

5 the first bucking bricks are disposed at first and second opposite sides of an outside periphery of the respective pole face and direct the blocking magnetic field toward a first center line of the respective pole face, and

10 the second bucking bricks are disposed at third and fourth opposite sides of the outside periphery of the respective pole face, adjacent the first and second opposite sides of the outside periphery of the respective pole face, and direct the blocking magnetic field toward a second center line of the respective pole face.

13. The magnet structure of claim 2, wherein an orientation of each said
15 brick determines a direction of the magnetic field produced by said brick.

14. The magnet structure of claim 13, wherein the orientation of each said brick is selected to direct a cumulative magnetic field produced by the plurality of bricks.

20 15. The magnet structure of claim 14, wherein the orientation of each said brick is selected to direct a cumulative magnetic field produced by the plurality of bricks toward the respective pole face.

21. The magnet structure of claim 1, wherein the first and second frame extensions are made from a magnetic material.

22. A magnet structure, comprising:

5 a first permanent magnet mass;

a first pole face disposed on the first permanent magnet mass;

a second permanent magnet mass;

a second pole face disposed on the second permanent magnet mass; and

a frame connecting the first permanent magnet mass to the second

10 permanent magnet mass, such that the first pole face is substantially opposite

and facing the second pole face to define a magnetic field volume in a gap

located between the first pole face and the second pole face.

23. The magnet structure of claim 22, wherein magnetic fields produced

15 by the first and second permanent magnet masses are directed toward the

respective pole faces.

24. The magnet structure of claim 22, wherein the first and second

permanent magnetic masses are respective first and second pluralities of bricks

20 made of magnetic material.

25. The magnet structure of claim 24, wherein the first and second pluralities of bricks are made of magnetic material selected from group consisting of rare earth metals.

5 26. The magnet structure of claim 22, wherein the first and second pluralities of bricks have geometries that allow a magnetic field direction for each said brick to be selected by physical arrangement of the brick.

10 27. The magnet structure of claim 22, wherein the first and second pluralities of bricks are arranged so that a cumulative effect of individual field directions of the bricks is a magnetic field directed toward the respective pole face.

15 28. The magnet structure of claim 24, wherein each said first and second pluralities of bricks includes main bricks oriented so as to direct a main magnetic field in a first direction, and bucking bricks oriented to direct a blocking magnetic field in a second direction.

20 29. The magnet structure of claim 28, wherein the main bricks are disposed behind the respective pole face and direct the main magnetic field generally toward the respective pole face, and the bucking bricks are disposed to one side of an outside periphery of the respective pole face and direct the blocking magnetic field toward a center line of the respective pole face.

30. The magnet structure of claim 28, wherein the main bricks are disposed behind the respective pole face and direct the main magnetic field generally toward the respective pole face, and the bucking bricks are disposed on two opposite sides of an outside periphery of the respective pole face and direct the blocking magnetic field toward a center line of the respective pole face.

31. The magnet structure of claim 28, wherein the main bricks are disposed behind the respective pole face and direct the main magnetic field generally toward the respective pole face, and the bucking bricks include first bucking bricks and second bucking bricks, wherein

the first bucking bricks are disposed at a first side of an outside periphery of the respective pole face and direct the blocking magnetic field toward a first center line of the respective pole face, and

the second bucking bricks are disposed at a second side of the outside periphery of the respective pole face, adjacent the first side of the outside periphery of the respective pole face, and direct the blocking magnetic field toward a second center line of the respective pole face.

32. The magnet structure of claim 28, wherein the main bricks are disposed behind the respective pole face and direct the main magnetic field generally toward the respective pole face, and

the bucking bricks include first bucking bricks and second bucking bricks,
wherein

the first bucking bricks are disposed at first and second opposite sides
of an outside periphery of the respective pole face and direct the blocking
magnetic field toward a first center line of the respective pole face, and

the second bucking bricks are disposed at third and fourth opposite
sides of the outside periphery of the respective pole face, adjacent the first
and second opposite sides of the outside periphery of the respective pole
face, and direct the blocking magnetic field toward a second center line of the
respective pole face.

33. The magnet structure of claim 24, further comprising first and second
enclosures in which the first and second pluralities of bricks are respectively
disposed, wherein the first and second enclosures are connected to the frame
and to the respective first and second pole faces.

34. The magnet structure of claim 33, wherein each said enclosure
includes an open end for inserting and removing quantities of the respective
pluralities of bricks, and a cover disposed over the open end.

35. The magnet structure of claim 34, wherein each said enclosure further
includes a brace connected between the cover and a first side of the enclosure
on which the pole face is disposed.

36. The magnet structure of claim 34, wherein each said enclosure further includes a brace connected between a first side of the enclosure, and a second side of the enclosure on which the pole face is disposed.

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37. The magnet structure of claim 22, wherein each said permanent magnetic mass includes a main magnetic mass providing a main magnetic field in a first direction, and a focusing magnetic mass providing a main magnetic field in a second direction.

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38. The magnet structure of claim 37, wherein the first direction is normal to a plane generally defined by a shape of the pole face, and where the second direction is parallel to the plane generally defined by a shape of the pole face.

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39. The magnet structure of claim 22, wherein the magnetic mass includes magnetic material selected from group consisting of rare earth metals.

40. The magnet structure of claim 22, wherein the magnetic mass includes discrete magnetic elements.

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41. The magnet structure of claim 40, wherein the discrete magnetic elements include magnetic material selected from group consisting of rare earth metals.

42. The magnet structure of claim 40, wherein a selectable orientation of each said discrete magnetic element determines a direction of the magnetic field produced by said discrete magnetic element.

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43. The magnet structure of claim 41, wherein the orientation of each said discrete magnetic element is selected to direct a cumulative magnetic field produced by the discrete magnetic elements toward the respective pole face.

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44. The magnet structure of claim 41, wherein the orientation of a first quantity of the discrete magnetic elements is selected to direct a cumulative magnetic field produced by the first quantity of discrete magnetic elements generally toward the respective pole face, and the orientation of a second quantity of the discrete magnetic elements is selected to focus the cumulative magnetic field produced by the first quantity of discrete magnetic elements toward a particular area of the respective pole face.

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45. The magnet structure of claim 44, wherein the particular area of the pole face includes the center of the pole face.

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46. The magnet structure of claim 44, wherein the first quantity of the discrete magnetic elements is disposed behind the respective pole face, and the

second quantity of the discrete magnetic elements is disposed outside of an outer periphery of the respective pole face.

47. The magnet structure of claim 22, wherein the frame further includes first and second slabs of magnetic material disposed on sides of the respective first and second permanent magnet masses opposite the sides of the respective permanent magnet masses on which the respective pole faces are disposed.

48. A magnet structure, comprising:
a frame, including first and second opposing frame ends and a plurality of spacers separating the first and second frame ends;
a first permanent magnet assembly, attached to the first frame end, including a first magnet enclosure, a first permanent magnet insert, and a first pole face disposed on an end of the first magnet enclosure; and
a second permanent magnet assembly, attached to the second frame end, including a second magnet enclosure, a second permanent magnet insert, and a second pole face disposed on an end of the second magnet enclosure.

49. The magnet structure of claim 48, wherein each of the first and second magnet enclosures includes a retainer, and a support connecting the retainer to the respective frame end, such that the respective permanent magnet insert is held between a first side of the retainer and the respective frame end, and the respective pole face is attached to a second side of the retainer.

50. The magnet structure of claim 48, wherein the first and second frame ends are made substantially of iron.

5 51. The magnet structure of claim 49, wherein each said retainer is made substantially of iron.

52. The magnet structure of claim 48, wherein each of the first and second frame ends is shaped substantially like a cross.

10 53. The magnet structure of claim 52, wherein the cross shape is supported by at least one gusset.

15 54. The magnet structure of claim 52, wherein the spacers connect corresponding ends of the cross shapes of the first and second frame ends.

20 55. The magnet structure of claim 48,
wherein first and second magnet enclosures each include an open end, a closed end, and a sidewall, defining an inside space in which the respective permanent magnet insert is disposed, and

wherein the first and second magnet enclosures are each attached to the respective frame end such that the open end is in direct communication with the respective frame end, and the respective pole face is attached to the closed end.

56. The magnet structure of claim 55, wherein each said inside space has a plan view that is shaped substantially like a rectangle.

5 57. The magnet structure of claim 56, wherein the first and second frame ends are each shaped substantially like a cross, and the sides of each of the inside spaces are substantially parallel with arms of the respective cross.

10 58. The magnet structure of claim 56, wherein the first and second frame ends are each shaped substantially like a cross, and the corners of each of the inside spaces are disposed on arms of the respective cross.

15 59. The magnet structure of claim 55, wherein the first and second magnet enclosures are made substantially of iron.

60. The magnet structure of claim 48, wherein the first and second permanent magnet inserts each include discrete magnetic elements.

20 61. The magnet structure of claim 60, wherein the discrete magnetic elements are made of magnetic material selected from group consisting of rare earth metals.

62. The magnet structure of claim 60, wherein the discrete magnetic elements have geometries that allow a magnetic field direction for each said discrete magnetic element to be selected.

5 63. The magnet structure of claim 62, wherein the discrete magnetic elements are arranged so that a cumulative effect of individual field directions of the discrete magnetic elements is a magnetic field directed toward the respective pole face.

10 64. The magnet structure of claim 62, wherein the discrete magnetic elements include a first group of discrete magnetic elements arranged to have a magnetic field directed generally toward the respective pole face, and a second group of discrete magnetic elements focusing the magnetic field toward a particular area on the respective pole face.

15 65. The magnet structure of claim 64, wherein the particular area on the respective pole face is the center of the pole face.

20 66. The magnet structure of claim 64,
wherein the second group of discrete magnetic elements is disposed between the first group of discrete magnetic elements and the respective pole face and outside an outer periphery of the respective pole face, and

wherein the second group of discrete magnetic elements produces a magnetic field that has a direction substantially parallel to the pole face.

67. The magnet structure of claim 48, wherein the first and second
5 permanent magnet inserts each include bricks made of magnetic material.

68. The magnet structure of claim 67, wherein the bricks are made of magnetic material selected from group consisting of rare earth metals.

10 69. The magnet structure of claim 67, wherein the bricks have geometries that allow a magnetic field direction for each said brick to be selected by physical arrangement of the brick.

15 70. The magnet structure of claim 69, wherein the bricks are arranged so that a cumulative effect of individual field directions of the bricks is a magnetic field directed toward the respective pole face.

20 71. The magnet structure of claim 69, wherein the bricks include a first group of bricks arranged to have a magnetic field directed generally toward the respective pole face, and a second group of bricks focusing the magnetic field toward a particular area on the respective pole face.

72. The magnet structure of claim 71, wherein the particular area on the respective pole face is an area including the center of the pole face.

73. The magnet structure of claim 71,

5 wherein the second group of bricks is disposed between the first group of bricks and the respective pole face and outside an outer periphery of the respective pole face, and

wherein the second group of bricks produces a magnetic field that has a direction substantially parallel to the pole face.

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